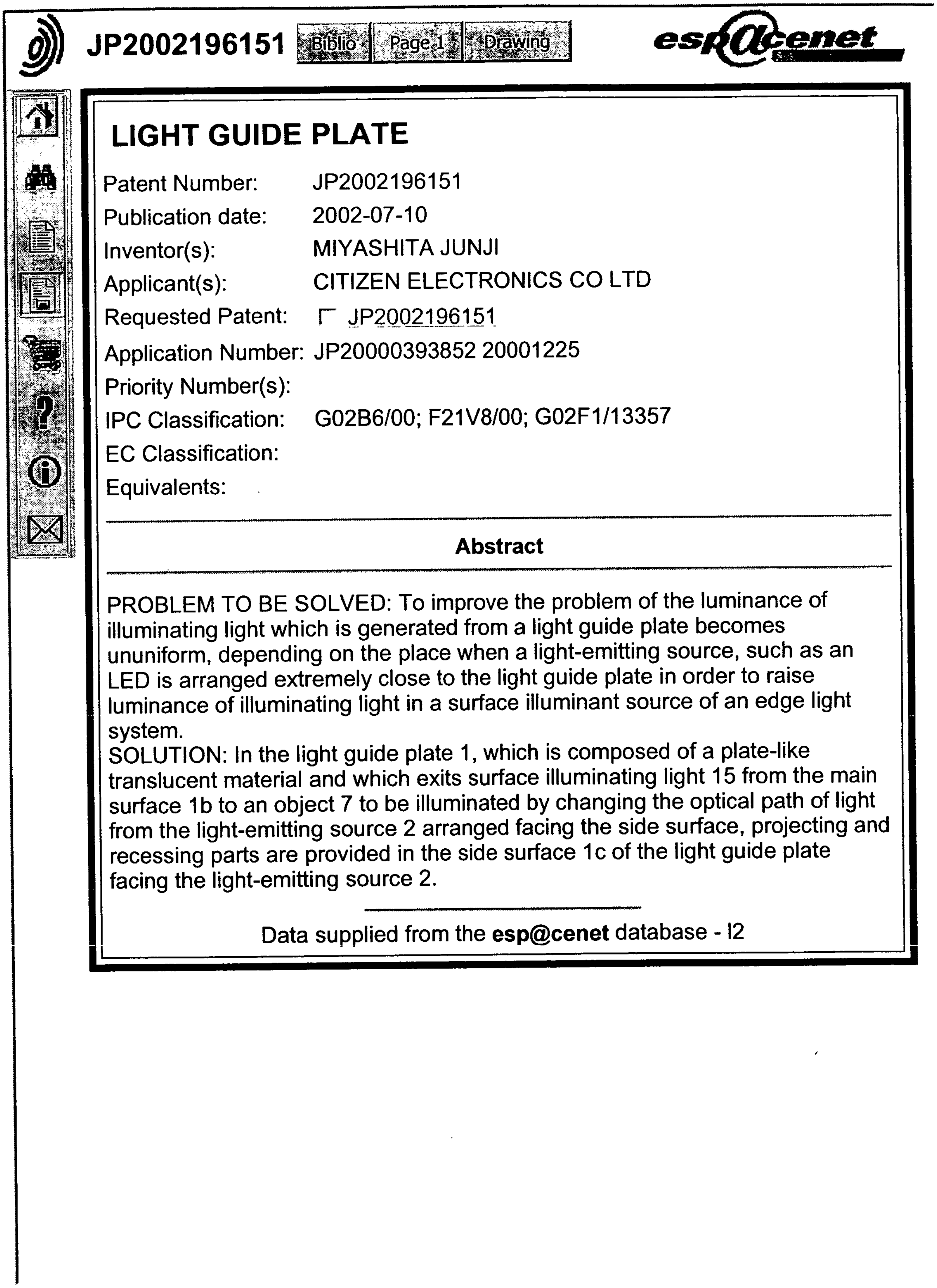

LIGHT GUIDE PLATE

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Abstract

PROBLEM TO BE SOLVED: To improve the problem of the luminance of illuminating light which is generated from a light guide plate becomes ununiform, depending on the place when a light-emitting source, such as an LED is arranged extremely close to the light guide plate in order to raise luminance of illuminating light in a surface illuminant source of an edge light system.

SOLUTION: In the light guide plate 1, which is composed of a plate-like translucent material and which exits surface illuminating light 15 from the main surface 1b to an object 7 to be illuminated by changing the optical path of light from the light-emitting source 2 arranged facing the side surface, projecting and recessing parts are provided in the side surface 1c of the light guide plate facing the light-emitting source 2.

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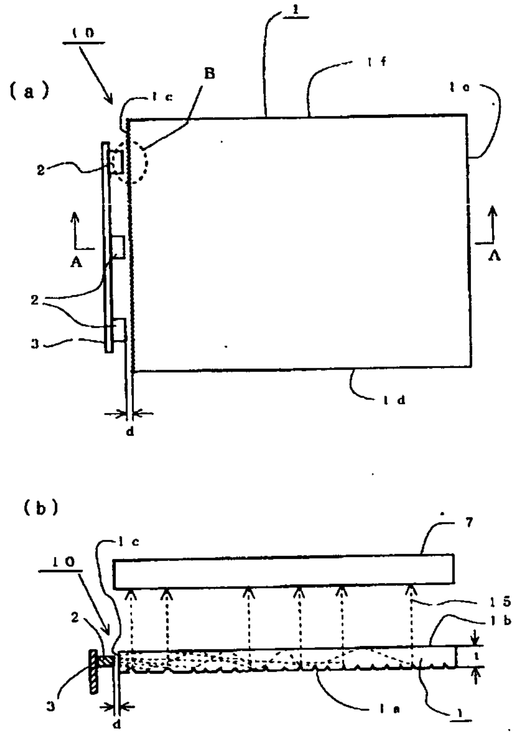
(54)【発明の名称】　導光板

(57)【要約】

【課題】　エッジライト方式の面状光源において照明光の明るさを上げるために、ＬＥＤ等の発光源を導光板に極く近接させた場合に、導光板より生ずる照明光の輝度が場所により不均一となる点を改善することを課題とする。

【解決手段】　板状の透光材よりなり、その側面に対向して配された発光光源２からの光を光路変換してその主面１ｂから照明対象物７に対し面状の照明光１５を出射する導光板１において、前記発光光源２と対向する導光板の側面１ｃに、凹凸を設けたことを特徴とする。



【特許請求の範囲】

【請求項１】　板状の透光材よりなり、その側面に対向して配された発光光源からの光を光路変換してその主面から照明対象物に対し面状の照明光を出射する導光板において、前記発光光源と対向する導光板の側面に、凹凸を設けたことを特徴とする導光板。

【請求項２】　前記導光板の側面に設けた凹凸は複数の均一なプリズムよりなることを特徴とする請求項１に記載の導光板。

【請求項３】　前記プリズムは導光板の厚み方向又はこれと斜交する方向に伸びていることを特徴とする請求項２に記載の導光板。

【請求項４】　前記導光板の側面に設けた凹凸は導光板の厚み方向又はこれと斜交する方向に伸びている断面が円弧状の複数の溝または突起であることを特徴とする請求項１に記載の導光板。

【請求項５】　前記導光板の側面に設けた凹凸は均一または不均一なシボであることを特徴とする請求項１に記載の導光板。

【請求項６】　前記発光光源と導光板との距離は導光板の厚さの（１／２）以下であることを特徴とする請求項１乃至請求項５のいずれかに記載の導光板。

【請求項７】　前記発光光源は１個又は複数個のＬＥＤよりなることを特徴とする請求項１乃至請求項６のいずれかに記載の導光板。

【請求項８】　前記複数個のＬＥＤには発光色の異なるＬＥＤが含まれることを特徴とする請求項７に記載の導光板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は例えば液晶パネルを背面より照射する面状光源に用いられる導光板に関する。

【０００２】

【従来の技術】近年、ブック型のワードプロセッサやコンピュータ、又は携帯電話機、携帯TVのような小型、薄型の情報機器の表示装置として、薄型でしかも見易いバックライト機構を有する液晶表示装置が用いられている。このようなバックライト機構としては、液晶パネルを背後から全面にわたり照射する面状光源が用いられており、この面状光源としては蛍光ランプ又はＬＥＤ（発光ダイオード）よりなる発光源と、その光束を液晶パネルに照射する面状の光束に変換する導光板よりなるものが一般的である。この中で、特に近年は、更なる小型、薄型化と長寿命化を目的として発光源としてＬＥＤ等を用いた面状光源が多く使用されるようになってきている。

【０００３】図６はこのようなうなＬＥＤ等の発光源を複数個、導光板の側面に配してなるエッジライト方式の面状光源において従来知られているものの構成を示す図であり、（ａ）は上面図、（ｂ）は（ａ）におけるＡ－Ａ断面図である。

【０００４】図６において、１１０は面状光源であり、導光板１０１と発光源として３個のＬＥＤ１０２を有している。導光板１０１は無色透明なプラスチック材等の透光部材よりなる板状で略直方体形状をしており、その一方の主面を光出射面１０１ｂとし、該光出射面１０１ｂと対向する面には、発光源からの光を前記光出射面１０１ｂに向けて反射させるための手段として、その表面に複数の微小なシボ又は複数個の半球状ドット等を有する光反射面１０１ａが形成されている。光出射面１０１ｂは鏡面仕上げされている。１０１ｃ、１０１ｄ、１０１ｅ、１０１ｆは導光板１０１の側面であり、鏡面仕上げされている。３個のＬＥＤ１０２はＬＥＤ基板１０３に支持されて導光板１０１の１つの側面１０１ｃに対向する位置に配設されている。

【０００５】図示しない駆動回路より所定の電流がＬＥＤ１０２に供給されるとＬＥＤ１０２は所定の色の光を発光、出射する。ＬＥＤ１０２からの出射光は前記側面１０１ｃから導光板１０１に入り、図６（ｂ）に示すように（大部分の光は）上面である光出射面１０１ｂで全反射、下面である光反射面１０１ａでは全反射又は乱反射を繰り返しながら、図６（ａ）に示すように側面１０１ｄ又は１０１ｆ、又は１０１ｅに向かって進行し、これらの側面で反射されて他の側面に向かって進行し、その進行の経路が広く導光板内に伝播される。このような伝播の際、導光板１０１の底面である光反射面１０１ａに設けられたシボ等により反射又は屈折した光が導光板の上面である光出射面１０１ｂから照明光１０５として外部に出射する。外部に出射した照明光１０５は（ｂ）に示すように液晶パネル１０７を背後から照明する。

【０００６】

【発明が解決しようとする課題】ここで、照明光１０５の明るさを上げるには図６に示すように、ＬＥＤ１０２と導光板１０１の距離（ｄ）を極力小さくすることが望ましい。距離を小さくするほどＬＥＤ１０２に対する導光板１０１の立体角が増え、導光板１０１に入射するＬＥＤ１０２の光束が増えるからである。しかしながら、前記の距離ｄを小さくして行くと次のような問題を生ずる。

【０００７】ＬＥＤ１０２の発光の対向側面１０１ｃへ入射した光は屈折により当該対向側面を透過し導光板１０１内に出射する。この際、入射角θ１と出射角θ２の関係は、空気の屈折率は１であるので導光板の屈折率をｎ２としたとき、スネルの定理により

$$\sin\theta 1\times 1=\sin\theta 2\times n2 \quad \cdots\cdots (1)$$

の関係があり、プラスチック材等よりなる導光板１０１の屈折率ｎ２は例えば１．５３であり、空気の屈折率１

より大であるから、（１）式より出射角θ２は入射角θ１よりも小となる。ここで、出射角θ２は導光板１０１の屈折率ｎ２で決まる臨界角θｃ例えば３９?（入射角θ１＝９０?の場合の出射角θ２に相当）を超えることはない。本例の場合、ＬＥＤ１０２の指向性、導光板との隙間等のため、図６（ａ）に示すようにＬＥＤ１０２から入光側面１０１ｃに対する実質的な入射光ｓ１の入射の領域はＬＥＤ１０２に対向する部分の近傍の部分となり、入射角θ１の最大値は９０?よりも若干小さくなる。よって出射光の出射角θ２は臨界角θｃより小さい値の範囲に制限される。このようにして、導光板１０１内部における光の伝播のルートは側面１０１ｃの近傍においては、側面１０１ｃのうちＬＥＤ１０２に対向部の近傍の部分から臨界角θｃより小さい角度で扇状に開いた扇形部分Ｇ内に限られてしまう。よって図６（ａ）に示すように、導光板１０１の側面１０１ｃの近傍には、前記扇形部分Ｇに隣接して光の伝播ルートが存在しない三角形状の広い空白部分Ｈを生ずる。そして、この空白部分Ｈにおいては、底面１０１ａにおけるシボ等はあるが、直接の照明光（１０５）の出射はなく、前記扇形部分Ｇからの回り込みこみにより生じた２次的な出射光が照明光となる。従って空白部分の照明光の輝度は扇形部分の照明光の輝度よりも大幅に低下し照明光の輝度の不均一を生ずる。

【０００８】このように、従来のエッジライト方式の面状光源に使用する導光板においては、導光板より出射する照明光の明るさを上げるために、ＬＥＤ等の発光源を導光板に極力近接させると、上記のような照明光の輝度の不均一の問題を生ずる。本発明はかかる問題を改善することを課題とするものである。すなわち、本発明は、ＬＥＤ等の発光源を導光板に極力近接させた状態で、照明光の輝度を十分に均一とすることのできる面状光源の導光板を提供すること目的とする。

【０００９】

【課題を解決するための手段】上記の課題を解決するためにその第１の手段として本発明は、板状の透光材よりなり、その側面に対向して配された発光光源からの光を光路変換してその主面からから照明対象物に対し面状の照明光を出射する導光板において、前記発光光源と対向する導光板の側面に、凹凸を設けたことを特徴とする。

【００１０】上記の課題を解決するためにその第２の手段として本発明は、前記第１の手段において、前記導光板の側面に設けた凹凸は複数の均一なプリズムよりなることを特徴とする。

【００１１】上記の課題を解決するためにその第３の手段として本発明は、前記第２の手段において、前記プリズムは導光板の厚み方向又はこれと斜交する方向に伸びていることを特徴とする。

【００１２】上記の課題を解決するためにその第４の手段として本発明は、前記第１の手段において、前記導光板の側面に設けた凹凸は導光板の厚み方向又はこれと斜交する方向に伸びている断面が円弧状の複数の溝または突起であることを特徴とする。

【００１３】上記の課題を解決するためにその第５の手段として本発明は、前記第１の手段において、前記導光板の側面に設けた凹凸は均一又は不均一なシボであることを特徴とする。

【００１４】上記の課題を解決するためにその第６の手段として本発明は、前記第１の手段乃至第５の手段のいずれかにおいて、前記発光光源と導光板との距離は導光板の厚さの（１／２）以下であることを特徴とする。

【００１５】上記の課題を解決するためにその第７の手段として本発明は、前記第１の手段乃至第６の手段のいずれかにおいて、前記発光光源は１個又は複数個のＬＥＤよりなることを特徴とする。

【００１６】上記の課題を解決するためにその第８の手段として本発明は、前記第７の手段において、前記複数個のＬＥＤには発光色の異なるＬＥＤが含まれることを特徴とする。

【００１７】

【発明の実施の形態】以下に、図面に基づいて本発明の第１の実施の形態に係る面状光源について説明する。図１は本実施の形態に係る導光板を用いたエッジライト方式の面状光源の構成を示す図であり、（ａ）は上面図、（ｂ）は（ａ）のＡ－Ａ断面図である。図１において、１０は面状光源であり、導光板１と発光源として３個のＬＥＤ２を有している。導光板１は透光性を有するプラスチック材等よりなり、板状で略直方体形状をしており、その一方の主面である上面１ｂは鏡面仕上げがなされ光出射面となっている。上面１ｂと対向する下面１ａには、発光源であるＬＥＤ２から導光板１内に入った光を前記上面１ｂに向けて反射させるための手段として、その表面に複数の微小なシボ又は複数個の半球状ドット等が設けられ、下面１ａは光反射面となっている。７は液晶パネルであり、導光板１の上面１ｂと対向する位置に配置されている。

【００１８】１ｃ、１ｄ、１ｅ、１ｆは導光板１の４つの側面であり、入光側面１ｃに対向してはＬＥＤ２が配置されている。３個のＬＥＤが側面１ｃとの距離ｄが極めて短くなる位置にＬＥＤ基板３に支持されて配設されており、前記距離ｄは、導光板の厚さをｔとしたとき、ｄ＜（ｔ／２）となっている。図１に示す例においてはｄ＝ｔ／４　程度となっている。このような近接配置としたのは、導光板１から出射する照明光の明るさを上げるためであり、このためには、ＬＥＤ１０２と導光板１０１の距離（ｄ）を極力小さくすることが望ましい。距離を小さくするほどＬＥＤに対する導光板１の立体角が増え、導光板１に入射するＬＥＤ２の光束が増えるからである。

【００１９】図２は図１のＢ部の拡大図であり、（ａ）

は上面図、（ｂ）は入光側面１ｃの斜視図である。図２に示すように、導光板１の入光側面１ｃには導光板の厚み方向に走る複数のプリズム状の凸部１ｃ１が均一に分布して凹凸が形成されている。ここで、凸部１ｃ１と凸部１ｃ１の間は導光板１の厚味方向に略並行な複数の尺状の平面部１ｃ２となっている。側面１ｃのこれら凹凸１ｃ１、１ｃ２の表面は鏡面仕上げとなっている。図１に示す導光板１の他の側面１ｄ、１ｅ、１ｆはそれぞれ、上面１ｂに略垂直な凹凸のない平面よりなり、それらの表面は鏡面仕上げされている。

【００２０】上記の構成において、図示しない駆動回路よりＬＥＤ２に所定の電流が供給されるとＬＥＤ２は所定の色、例えば略白色の光を発光、出射する。ＬＥＤからの出射光は前記入光側面１ｃから導光板１に入り、図１（ｂ）に示すように（大部分の光は）上面である光出射面１ｂで全反射、下面である光反射面１ａでは全反射又は乱反射を繰り返しながら、後述の図３にも示すように、側面１ｄ又はｆ、又はｅに向かって進行し、一部がこれらの側面で反射される等して、その進行の経路が広く導光板内に伝播される。このような伝播の際、導光板１の下面１ａである光反射面に設けられた多数のドット状窪み又は半球状ドット等よりなるシボにより反射又は屈折した光が導光板の上面１ｂである光出射面から照明光１５として外部に出射する。外部に出射した照明光１５は図１（ｂ）に示すように液晶パネル７を背後から照明する。

【００２１】上記の照明の際、ＬＥＤから出射した光の大部分は導光板１の側面１ｃに達する。これは、上記のように、ＬＥＤ２と側面１ｃの距離ｄは極力小さくなっているので、前記出射光は十分広い立体角の範囲で側面１ｃに達するからである。本実施の形態における導光板１の材料は例えばポリカーボネイトありこの場合、屈折率は　１．５３　であり、臨界角θｃは略　θｃ＝３９?である。図２に示すように、側面１ｃに達した光線のうち、平面部１ｃ２に対し入射する光線ｓ１についての挙動は、すでに図６を用いて説明した従来の導光板の場合と略同様であり、説明を省略する。次に入光側面１ｃの凸部１ｃ１に入射する光線ｓ２の挙動について説明する前に、入射角θ１の変化に伴う出射角θ２の変化の傾向につき一般的な説明をする。空気中から本例の導光板のように屈折率が１より高い部材に対し光の入射がなされた場合、入射角θ１が小さいものについて出射角θ２との差である屈折の曲がり　Δθ＝θ１−θ２　は小さく、出射光は入射光の延長に近い方向にある。一方、入射角θ１が大きくなると屈折の曲がりである前記のΔθは大きくなり、出射光は入射光の延長から内側に向けて大きく傾斜した角度をとる。この理由は（１）式に示したスネルの原理により説明できる。すなわち、（１）式によれば、入射角θ１が９０?のときは曲がりの角度Δθ＝θ１−θ２　は　９０?−θｃ（臨界角）となり例えば略　Δθ＝５０?となるが、入射角θ１が減少すると、曲がりの角度Δθも減少し、入射角θ１が０?に近づけば曲がりの角度Δθも０?に近づく。

【００２２】ここで、入光側面１ｃの凸部１ｃ１のプリズム面に入射したｓ２光線については、その面の傾斜角αの効果により、従来よりも出射角θ２を効果的に増大することができる。この理由は、入射光ｓ２の入射角について前記平面部１ｃ２を基準とした入射角θ１が比較的大であっても、前記プリズム面における実際の入射角θ１ｅは　θ１ｅ＝θ１−α　となり、θ１よりもかなり減少するので、上記した原理により、曲がりの角度Δθも減少し、出射光の方向は入射光ｓ２の延長に近い方向となるからである。よって、前記プリズム面の傾斜角αを適切に設定すれば、平面部１ｃ２の面を基準とした出射角θ２を臨界角θｃを超える範囲にまで十分に増大させることができる。以上を要約すれば、本実施の形態においては、入光側面１ｃ設けたプリズム状の凸部１ｃ１におけるプリズム面の傾斜の効果により、入光側面１ｃに入射する入射角θ１が大きい光線に対しても出射角θ２を従来よりも増大させ、結果として入光側面１ｃ全体に関し、導光板１内部への出射光の角度範囲を従来よりも大幅に増大させることができる。なお、プリズム状の凸部１ｃ１から内部に入射した光線は、入射面であるプリズムの面が導光板１の厚味方向に略並行に伸びているので、屈折により上下に分散して、ただちに導光板１外に出てしまうことは少なく、導光板１内を広く伝播した状態で照明光に変換される。このような効果はプリズム面が導光板の厚味方向に斜交している場合でも得られることがある。

【００２３】図３は本第１の実施の形態における導光板１の内部の光伝播路の分布状態を示す上面図である。入射光は実質的には図６に示す従来の面状光源と同様にＬＥＤの対向部の近傍の範囲において導光板１に入射するので、光伝播路１１ｓの出発する際の領域の幅は従来と同様であるが、光伝播路１１ｓの出発の際の方向は、上記した原理により、その角度範囲が臨界角θｃを超えて従来よりもかなり広い角度範囲にとなっている。よって、側面１ｃ近傍の光伝播路１１ｓの存在領域Ｇ１は従来よりも広がっている。存在領域Ｇ１の側方には光伝播路１１ｓが存在せず、直接には照明光（１５）が出射しない空白領域Ｈ１があるが、図６に示す従来の導光板の場合よりも、存在領域が広がった分だけ空白領域は大幅に縮小している。なお、空白領域Ｈ１においてもその底面にはシボがあり、存在領域Ｇ１の底面のシボによる光の散乱に起因する２次的な回り込みを受けて、空白領域Ｈ１においても、その底面のシボの作用で間接的には照明光を出射する。ただし、従来のように空白領域が広いと、その中央部を含む大部分で大幅に輝度が低下し、輝度の顕著な不均一をもたらしていた。しかしながら、本実施の形態においては、空白領域Ｈ１の広さは従来より

も十分に狭く、回りこみによる照明光の輝度は存在領域Ｇ１の輝度に比してあまり低下していない。よって、導光板１の入光側面１ｃの近傍においても、照明光１５の輝度は実質的に均一となる。

【００２４】従って、本第１の実施の形態によれば、照明光を明るくするために、ＬＥＤを導光板の側面に極めて近接して配置した場合、①導光板から出射する照明光の輝度の均一性を従来よりも効果的に高めることができる。②これにより、照明されるパネルの表示品質を高めることができる。なお、本第１の実施の形態においては、発光源として複数個のＬＥＤを用いたが、本発明はこれに限らず、導光板の形状によっては１個のＬＥＤのみを用いた場合でも、同様の効果が得られる。また、複数個のＬＥＤの発光色は同一色に限らず、Ｒ、Ｇ、Ｂ等異なった発光色のものであっても、混色による照明光の輝度の均一性が従来よりも向上する。

【００２５】以下に、図面に基づいて本発明の第２の実施の形態に係る導光板について説明する。図４は本第２の実施の形態に係る導光板を用いたエッジライト方式の面状光源の入光側面の近傍の構成を示す部分的拡大図であり、（ａ）は上面図、（ｂ）は入光側面の斜視図である。なお、本第２の実施の形態に係る面状光源全体の構成および部材の記号は、前記光入射側面を除き図１に示した面状光源の場合と同様である。図４に示すように導光板１の入光側面１ｃには導光板の厚み方向に伸びる断面が円弧状の複数の溝１ｃ３が略均一に分布して設けられている。溝１ｃ３と溝１ｃ３の間は平面部１ｃ４となっている。

【００２６】図４（ａ）に示すように、ＬＥＤ２から入光側面１ｃに達した光のうち、溝１ｃ３の底部および、平面部１ｃ４を透過、屈折するものの挙動は図６に示す従来例で説明した入射光の同様であり説明を省略する。溝１ｃ３の側部に入射する光線に関しては入射面の傾斜の効果により、すでに第１の実施形態において説明したのと基本的には同様の原理により、平面部１ｃ４を基準とした見た出射角の角度範囲を臨界角を超えて従来よりも大幅に広げることができる。なお、溝１ｃ３から導光板１の内部に出射した光線は、入射面である溝の面が導光板の厚味方向に略並行となっているので、ただちに屈折により、上下に散乱して導光板１外に出てしまうことは少なく、導光板１内を広く伝播した状態で照明光に変換される。このようにして、本第３の実施の形態においても、図１に示した第１の実施の形態の場合と同様に、入光側面１ｃの近傍の導光板１内の光伝播路の存在領域（Ｇ１）を従来よりも大幅に広げ、光伝播路が存在しない空白領域（Ｈ１）を従来よりも縮小することができる。よって、本第２の実施の形態も、すでに説明した第１の実施の形態と同様の効果を有する。

【００２７】なお、図示は省略するが、本第２の実施の形態の変形例として、断面円弧状で、導光板の厚味方向に伸びるカマボコ状の複数の凸部を有するものがある。この場合もカマボコ状の凸部において、広い角度範囲において入射光を透過させ、第２の実施の形態と同様の効果を得ることができる。

【００２８】以下に、図面に基づいて本発明の第３の実施の形態に係る導光板について説明する。本第３の実施の形態は導光板１の入光側面に各種のシボ等の凹凸を設けた例に関するものである。図５は第３の実施の形態に各種のシボ等の形状を示す入光側面１ｃの部分的な拡大斜視図であり、（ａ）は多数の微小な半球の窪み２１を有するシボを示す図、（ｂ）は多数の微小な半球状の凸部２２を有するシボを示す図、（ｃ）は多数の微小な角錐状の窪み２３を有するシボを示す図、（ｄ）は多数の微小な円錐状の凸部２４を有するシボを示す図、（ｅ）は多数の微小な角錐状の凸部２５を有するシボを示す図である。（ｆ）はシボとは言えないが、後述するヘアライン状の凹凸２６を示す図である。なお、本第３の実施の形態に係る導光板を用いた面状光源全体の構成は、前記光入射側面を除き図１に示した面状光源の場合と同様である。

【００２９】これらのシボにおいて、半球状の窪み２１、は角錐状の窪み２３に達した入射光はその窪みの内面の入射面の傾斜効果により、すでに説明したのと同様の原理で、導光板１内部への出射光の出射角を大とすることができる。また、半球状の凸部２２、円錐状の凸部２４、角錐状の凸部２５に達した入射光についても入射面の傾斜効果により同様の傾向がある。このようにして、かかるシボ加工がなされた入光側面１ｃに達した光の屈折による導光板内部への出射の出射光については、全体として見た場合、従来は臨界角以下に制限されていた出射光の角度範囲をこれよりも大幅に広げることが可能となる。よって、すでに説明したのと同様の原理により、従来よりも導光板から出射する照明光の輝度の均一化を改善することができる。

【００３０】なお、シボの形状としてはこの他に図示は省略するが、多数の円錐状の窪みよりなるものがある。これまで述べてきた入光側面１ｃのシボの形状に関しては、図５（ａ）、（ｂ）、（ｃ）、（ｄ）、（ｅ）に示すように、同一の寸法の凸部又は窪みが均一に配列されているものであったが、本発明に係るシボの形状はこれに限らず、不均一な寸法の凸部又は窪みが不規則に配列されている場合においても前記のシボと同様の効果を有する。

【００３１】次に図５（ｆ）はシボとはいえないが、入光側面１ｃに設けられたヘアライン形状の不規則な凹部２６（又は凸部であってもよい。）を示す斜視図である。かかるヘアライン形状の凹部（又は凸部）２６を有する入光側面１ｃも前記のシボを有する入光側面１ｃと基本的には同様の原理により同様の作用をなし、導光板に対し略同様の改善効果を与える。

【0032】

【発明の効果】以上に説明したように、本発明によれば、エッジライト方式の面状光源において、導光板より出射する照明光の明るさを上げるために、ＬＥＤ等の発光源を導光板に極力近接させた場合においても、①導光板から出射する照明光の輝度の均一性を従来よりも高めことが出来、②これにより、照明されるパネルの表示品質を高めることができる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態に係る導光板を用いた面状光源の構成を示す図である。

【図２】図１におけるＢ部の拡大図である。

【図３】図１に示す面状光源に用いる導光板の内部の光伝播路の分布状態を示す上面図である。

【図４】本発明の第２の実施の形態に係る導光板の入光側面の形状を示す図である。

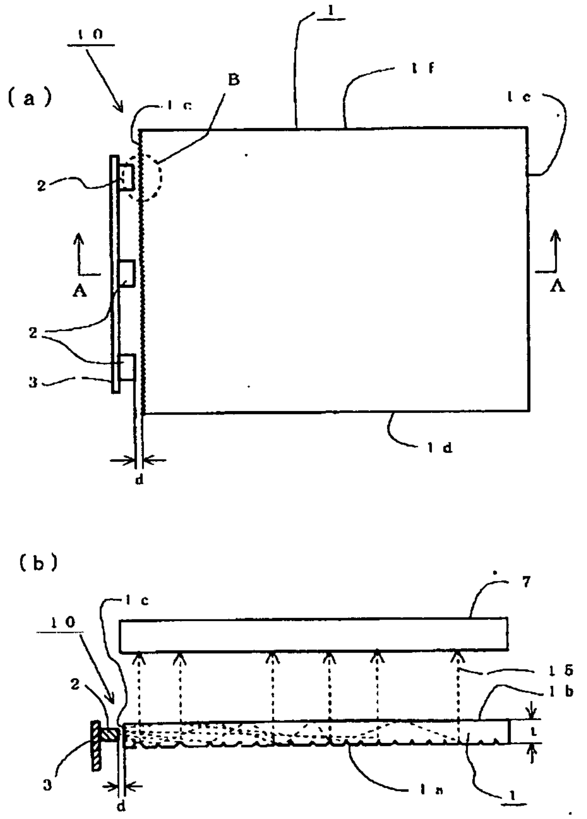
【図５】本発明の第３の実施の形態に係る導光板の入光側面の形状を示す図である。

【図６】従来の導光板を用いた面状光源の構成を示す図である。

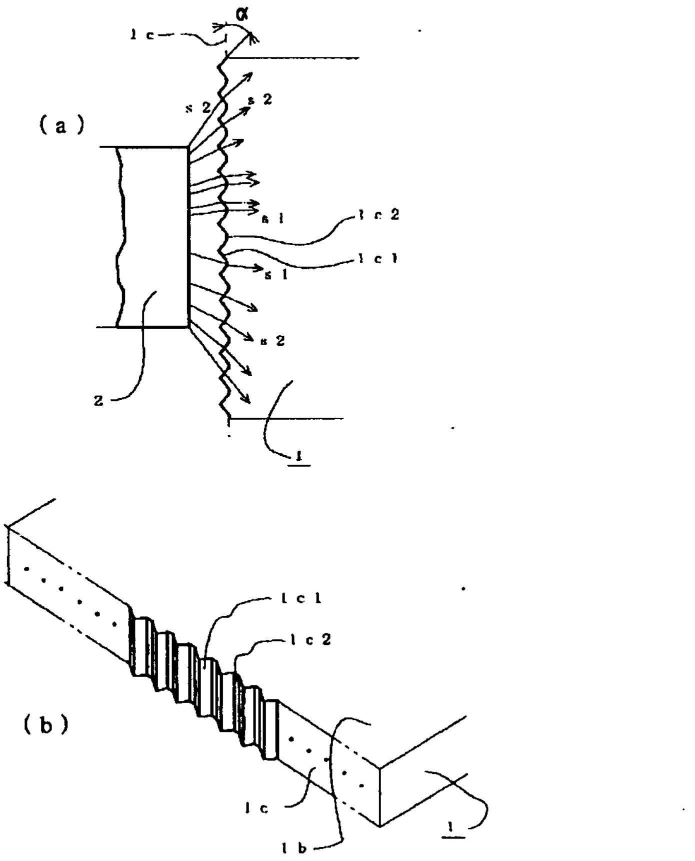
【符号の説明】

１	導光板
１ｃ	入光側面
１ｃ１	プリズム状凸部
１ｃ２、１ｃ４	平面部
１ｃ３	溝
２	ＬＥＤ
３	ＬＥＤ基板
７	液晶パネル
１０	面状光源
１１ｓ	光伝播路
１５	照明光
２１、２２、２３，２４、２５	シボ
２６	ヘアライン
Ｇ１	存在領域
Ｈ１	空白領域

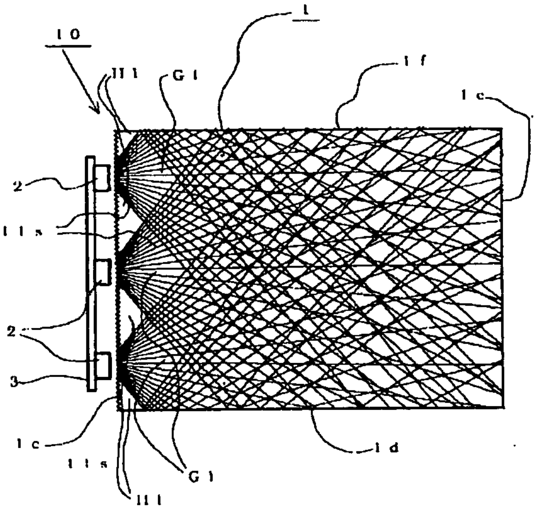
【図１】



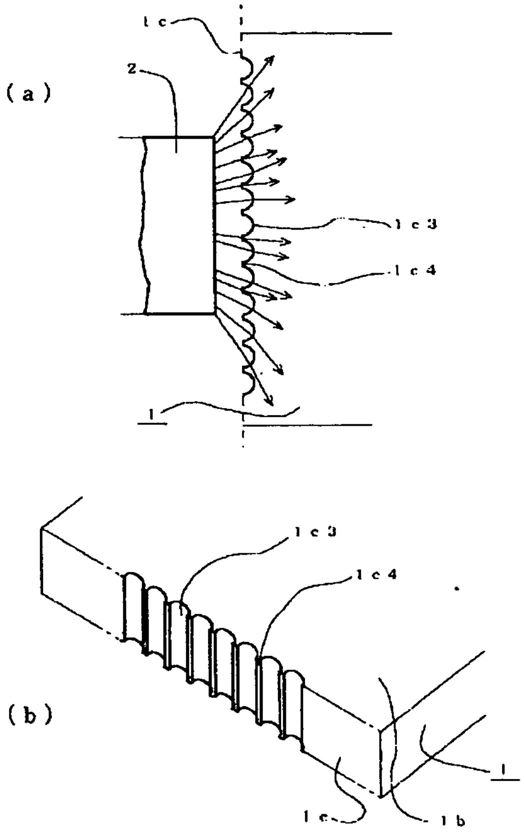
【図２】



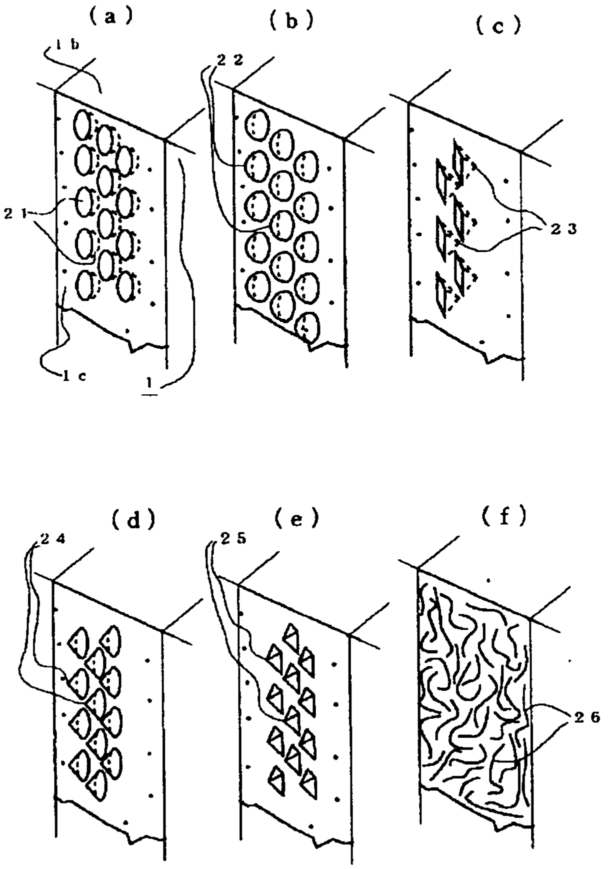
【図3】


1
10
H1
G1
1f
1c
2
11s
2
3
1c
11s
G1
H1
1d

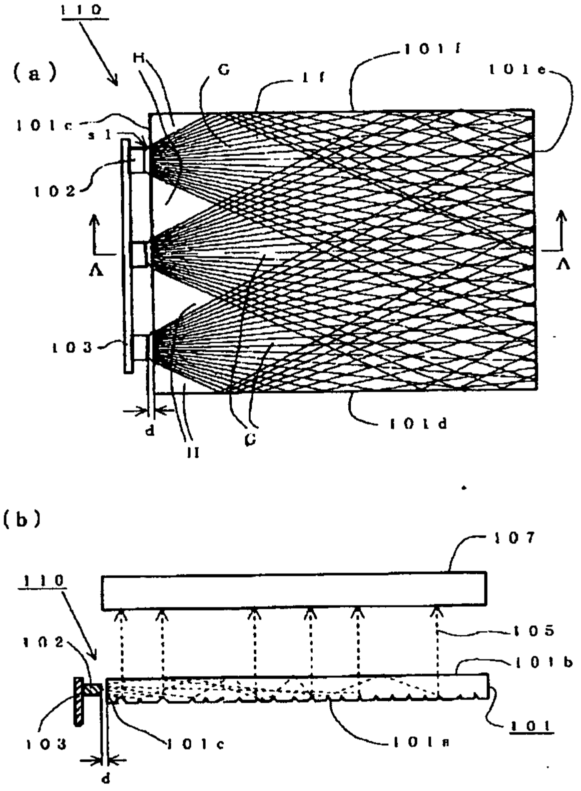
【図4】


(a)
1c
2
1c3
1c4
1
(b)
1c3
1c4
1
1c
1b

【図5】


(a)
(b)
(c)
1b
22
21
23
1c
1
(d)
(e)
(f)
24
25
26

【図6】


(a)
H
G
s1
A
A
d
H
G
(b)
d

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(22)Date of filing : 25.12.2000
(71)Applicant : CITIZEN ELECTRONICS CO LTD
(72)Inventor : MIYASHITA JUNJI

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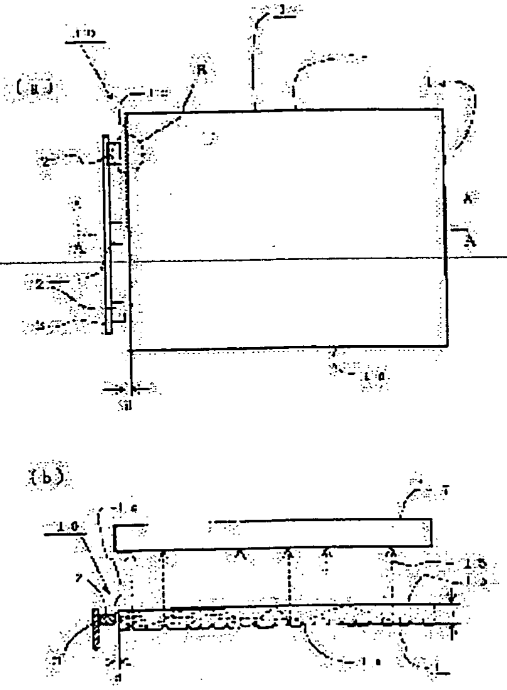
(54) LIGHT GUIDE PLATE

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the problem of the luminance of illuminating light which is generated from a light guide plate becomes ununiform, depending on the place when a light-emitting source, such as an LED is arranged extremely close to the light guide plate in order to raise luminance of illuminating light in a surface illuminant source of an edge light system.

SOLUTION: In the light guide plate 1, which is composed of a plate-like translucent material and which exits surface illuminating light 15 from the main surface 1b to an object 7 to be illuminated by changing the optical path of light from the light-emitting source 2 arranged facing the side surface, projecting and recessing parts are provided in the side surface 1c of the light guide plate facing the light-emitting source 2.



(11)Publication number : 2002-196151 (54) LIGHT GUIDE PLATE

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(21)Application number : 2000-393852 (71)Applicant : CITIZEN ELECTRONICS CO LTD
(22)Date of filing : 25.12.2000 (72)Inventor : MIYASHITA JUNJI

[Claim(s)]

[Claim 1]
The light guide plate characterized by preparing irregularity in the side of the aforementioned luminescence light source and the light guide plate which counters in the light guide plate which consists of a translucent material of a tabular, carries out optical-path conversion of the light from the luminescence light source which countered the side and was arranged, and carries out outgoing radiation of the field-like lighting light from the principal plane to a lighting object.

[Claim 2]
The irregularity prepared in the side of the aforementioned light guide plate is a light guide plate according to claim 1 characterized by the bird clapper from two or more uniform prism.

[Claim 3]
The aforementioned prism is a light guide plate according to claim 2 characterized by being extended in the thickness direction of a light guide plate or this, and the direction crossing diagonally.

[Claim 4]
The irregularity prepared in the side of the aforementioned light guide plate is a light guide plate according to claim 1 characterized by the cross sections extended in the thickness direction of a light guide plate or this, and the direction crossing diagonally being two or more circular slots or a salient.

[Claim 5]
The irregularity prepared in the side of the aforementioned light guide plate is a light guide plate according to claim 1 characterized by being a uniform or uneven crimp.

[Claim 6]
The distance of the aforementioned luminescence light source and a light guide plate is a light guide plate according to claim 1 to 5 characterized by being the following (1/2) of the thickness of a light guide plate.

[Claim 7]
The aforementioned luminescence light source is a light guide plate according to claim 1 to 6 characterized by the bird clapper from one piece or two or more Light Emitting Diodes.

[Claim 8]
The light guide plate according to claim 7 characterized by containing in two or more aforementioned Light Emitting Diodes Light Emitting Diode from which the luminescent color differs.

[Detailed Description of the Invention]

[0001]
[The technical field to which invention belongs]
This invention relates to the light guide plate used for the field-like light source which irradiates a liquid crystal panel from a tooth back.

[0002]
[Description of the Prior Art]
In recent years, the liquid crystal display which moreover has a legible back light mechanism with a thin shape as display of the information machines and equipment of the word processor and computer of a book mold or a portable telephone, small [like cellular phone TV], and a thin shape is used. The field-like light source which irradiates a liquid crystal panel over the whole surface from behind as such a back light mechanism is used, and what consists of a source of luminescence which consists of a fluorescent lamp or a Light Emitting Diode (light emitting diode) as this field-like light source, and a light guide plate which changes the flux of light into the flux of

light of the shape of a field which irradiates a liquid crystal panel is common. In this, the source of luminescence takes especially in recent years for the purpose of small [further], and thin-shape-izing and reinforcement, and many field-like light sources using Light Emitting Diode etc. are used increasingly.

[0003] Drawing 6 is drawing showing composition, although conventionally known in the field-like light source of the edge light method which comes to allot two or more sources of luminescence, such as Light Emitting Diode [twist / in this way], to the side of a light guide plate, and it is an A-A cross section / in / (a) / (a) and / in (b)]. / a plan

[0004] In drawing 6 , 110 is the field-like light source and has three Light Emitting Diodes102 as a light guide plate 101 and a source of luminescence. The light guide plate 101 is carrying out the abbreviation rectangular parallelepiped configuration with the tabular which consists of translucent part material, such as transparent and colorless plastics material, set the principal plane of one of these to optical outgoing radiation side 101b, and in this optical outgoing radiation side 101b and the field which counters As a means for turning and reflecting the light from the source of luminescence in the aforementioned optical outgoing radiation side 101b, light reflex side 101a which has two or more minute crimp or two or more semi-sphere-like dots etc. is formed in the front face. The mirror finish of the optical outgoing radiation side 101b is carried out. 101c, 101d, 101e, and 101f are the sides of a light guide plate 101, and the mirror finish is carried out. Three Light Emitting Diodes102 are arranged in the position which is supported by the Light Emitting Diode substrate 103 and counters one side 101c of a light guide plate 101.

[0005] If predetermined current is supplied to Light Emitting Diode102 from the drive circuit which is not illustrated, light will be emitted and Light Emitting Diode102 will carry out outgoing radiation of the light of a predetermined color. The outgoing radiation light from Light Emitting Diode102 goes into a light guide plate 101 from aforementioned side 101c. As shown in drawing 6 (b), while repeating total reflection or a scattered reflection in light reflex side 101a which is total reflection and an inferior surface of tongue in optical outgoing radiation side 101b which is the upper surface (a great portion of light) As shown in drawing 6 (a), it goes on toward 101d of sides, 101f, or 101e, and it is reflected on these sides, and goes on toward other sides, and the path of the advance spreads in a light guide plate widely. The light reflected or refracted by the crimp prepared in light reflex side 101a which is the base of a light guide plate 101 carries out outgoing radiation outside as a lighting light 105 from optical outgoing radiation side 101b which is the upper surface of a light guide plate in the case of such propagation. The lighting light 105 which carried out outgoing radiation outside illuminates a liquid crystal panel 107 from behind, as shown in (b).

[0006]
[Problem(s) to be Solved by the Invention]
It is desirable to make small distance (d) of Light Emitting Diode102 and a light guide plate 101 as much as possible here, as shown in drawing 6 , for raising the luminosity of the lighting light 105. It is because the solid angle of a light guide plate 101 to Light Emitting Diode102 increases and the flux of light of Light Emitting Diode102 which carries out incidence to a light guide plate 101 increases so that distance is made small. However, the following problems will be produced, if the aforementioned distance d is made small and it goes.

[0007] The light which carried out incidence to opposite side 101c of luminescence of Light Emitting Diode102 penetrates the opposite side concerned by refraction, and it carries out outgoing radiation into a light guide plate 101. Under the present circumstances, since the refractive index of air was 1, when the relation between an incident angle theta 1 and the outgoing radiation angle theta 2 sets the refractive index of a light guide plate to n2, it is sintheta1x1= by the theorem of Snell. sintheta2xn2 ..... (1)
There is ******, the refractive index n2 of the light guide plate 101 which consists of plastics material etc. is 1.53, and since it is size, the outgoing radiation angle theta 2 serves as [refractive index / of air / 1] smallness from an incident angle theta 1 from (1) formula. Here, the outgoing radiation angle theta 2 does not exceed, critical angle thetac (equivalent to the outgoing radiation angle theta 2 in incident angle theta1=90?), for example, 39?, decided by the refractive index n2 of a light guide plate 101. In this example, for the directivity of Light Emitting Diode102, the crevice between light guide plates, etc., as shown in drawing 6 (a), the field of the incidence of the substantial incident light s1 to ON light side 101c serves as a portion near the portion which counters Light Emitting Diode102 from Light Emitting Diode102, and as for the maximum of an incident angle theta 1, 90? twist also becomes small a little. Therefore, the outgoing radiation angle theta 2 of outgoing radiation light is restricted to the range of a value smaller than critical angle thetac. Thus, the root of propagation of the light in the light guide plate 101 interior will be restricted [near the side 101c] in the splay part G opened from the portion near the opposite section at the angle smaller than critical angle thetac to Light Emitting Diode102 among side 101c at the flabellate. Therefore, as shown in drawing 6 (a), near the side 101c of a light guide plate 101, the latus blank portion H of the shape of a triangle in which the aforementioned splay part G is adjoined and the propagation root of light does not exist is

produced. and — although there is a crimp in base 101a etc. in this blank portion H — the outgoing radiation of a direct lighting light (105) — there is nothing — from the aforementioned splay part G — turning — crowded — being crowded — a produced-like secondary outgoing radiation light turns into lighting light Therefore, the brightness of the lighting light of a blank portion falls more sharply than the brightness of the lighting light for a splay, and produces the ununiformity of the brightness of lighting light.

[0008] Thus, in the light guide plate used for the field-like light source of the conventional edge light method, if sources of luminescence, such as Light Emitting Diode, are made to approach a light guide plate as much as possible in order to raise the luminosity of the lighting light which carries out outgoing radiation from a light guide plate, the problem that the brightness of the above lighting light is uneven will be produced. this invention makes it a technical problem to improve this problem. That is, this invention is in the state where sources of luminescence, such as Light Emitting Diode, were made to approach a light guide plate as much as possible, and let it be the offering-light guide plate of the field-like light source which can make brightness of lighting light uniform enough purpose.

[0009]
[Means for Solving the Problem]
In the light guide plate which this invention consists of a translucent material of a tabular as the 1st means in order to solve the above-mentioned technical problem, and carries out optical-path conversion of the light from the luminescence light source which countered the side and was arranged, and carries out outgoing radiation of the field-like lighting light from the principal plane to a shell lighting object, it is characterized by preparing irregularity in the side of the aforementioned luminescence light source and the light guide plate which counters.

[0010] In order to solve the above-mentioned technical problem, irregularity which prepared this invention in the side of the aforementioned light guide plate in the 1st means of the above is characterized by the bird clapper from two or more uniform prism as the 2nd means.

[0011] In order to solve the above-mentioned technical problem, this invention is characterized by having extended the aforementioned prism in the thickness direction of a light guide plate or this, and the direction crossing diagonally in the 2nd means of the above as the 3rd means.

[0012] In order to solve the above-mentioned technical problem, irregularity which prepared this invention in the side of the aforementioned light guide plate in the 1st means of the above is characterized by the cross sections extended in the thickness direction of a light guide plate or this, and the direction crossing diagonally being two or more circular slots or a salient as the 4th means.

[0013] In order to solve the above-mentioned technical problem, it is characterized by being a crimp uniform [the irregularity which prepared this invention in the side of the aforementioned light guide plate in the 1st means of the above], or uneven as the 5th means.

[0014] In order to solve the above-mentioned technical problem, this invention is characterized by the distance of the aforementioned luminescence light source and a light guide plate being the following (1/2) of the thickness of a light guide plate in either the 1st means of the above, or the 5th means as the 6th means.

[0015] In order to solve the above-mentioned technical problem, in either the 1st means of the above, or the 6th means, the aforementioned luminescence light source is characterized by the bird clapper from one piece or two or more Light Emitting Diodes by this invention as the 7th means.

[0016] In order to solve the above-mentioned technical problem, this invention is characterized by containing in two or more aforementioned Light Emitting Diodes Light Emitting Diode from which the luminescent color differs in the 7th means of the above as a means of the octavus.

[0017]
[Embodiments of the Invention]
The field-like light source applied to the gestalt of operation of the 1st of this invention below based on a drawing is explained. Drawing 1 is drawing showing the composition of the field-like light source of an edge light method using the light guide plate concerning the gestalt of this operation, (a) is a plan and (b) is the A-A cross section of (a). In drawing 1 , 10 is the field-like light source and has three Light Emitting Diodes2 as a light guide plate 1 and a source of luminescence. A light guide plate 1 consists of plastics material which has a translucency, the abbreviation rectangular parallelepiped configuration is carried out with the tabular, a mirror finish is made and upper surface 1b which is the principal plane of one of these has become an optical outgoing radiation side. As a

means for making the aforementioned upper surface 1b turn and reflect the light which entered in the light guide plate 1 in upper surface 1b and inferior-surface-of-tongue 1a which counters from Light Emitting Diode2 which is a source of luminescence, two or more minute crimp or two or more semi-sphere-like dots etc. are prepared in the front face, and inferior-surface-of-tongue 1a has become a light reflex side. 7 is a liquid crystal panel and is arranged in upper surface 1b of a light guide plate 1, and the position which counters.

[0018] 1c, 1d, 1e, and 1f are four sides of a light guide plate 1, and if ON light side 1c is countered, Light Emitting Diode2 is arranged. Three Light Emitting Diodes are supported and arranged in the position where the distance d with side 1c becomes very short by the Light Emitting Diode substrate 3, and the aforementioned distance d is d< (t/2), when thickness of a light guide plate is set to t. It sets for the example shown in drawing 1 , and is d=t/4. It is a grade. It considered as such contiguity arrangement for raising the luminosity of the lighting light which carries out outgoing radiation from a light guide plate 1, and, for that, it is desirable to make small distance (d) of Light Emitting Diode102 and a light guide plate 101 as much as possible. It is because the solid angle of a light guide plate 1 to Light Emitting Diode increases and the flux of light of Light Emitting Diode2 which carries out incidence to a light guide plate 1 increases so that distance is made small.

[0019] Drawing 2 is the enlarged view of the B section of drawing 1 , (a) is a plan and (b) is the perspective diagram of ON light side 1c. As shown in drawing 2 , the heights 1c1 of the shape of two or more prism which runs in the thickness direction of a light guide plate are uniformly distributed over ON light side 1c of a light guide plate 1, and irregularity is formed. here -- between heights 1c1 and heights 1c1 -- the direction of the thick taste of a light guide plate 1 -- abbreviation -- it is the flat-surface section 1c2 of two or more shape of parallel ** These irregularity 1c1 of side 1c and the front face of 1c2 serve as a mirror finish. other sides 1d, 1e, and 1f of the light guide plate 1 shown in drawing 1 -- respectively -- upper surface 1b -- abbreviation -- it consists of a flat surface without perpendicular irregularity, and the mirror finish of those front faces is carried out

[0020] In the above-mentioned composition, if predetermined current is supplied to Light Emitting Diode2 from the drive circuit which is not illustrated, light will be emitted and Light Emitting Diode2 will carry out outgoing radiation of the light of a predetermined color, for example, abbreviation white. As the outgoing radiation light from Light Emitting Diode goes into a light guide plate 1 from aforementioned ON light side 1c and it is shown in drawing 1 (b), while repeating total reflection or a scattered reflection in light reflex side 1a which is total reflection and an inferior surface of tongue in optical outgoing radiation side 1b which is the upper surface (a great portion of light) As shown also in below-mentioned drawing 3 , it goes on toward 1d of sides, f, or e, it carries out [that a part is reflected on these sides, etc. and], and the path of the advance spreads in a light guide plate widely. The light reflected or refracted by the crimp which consists of many dot-like hollows or semi-sphere-like dots etc. which were prepared in the light reflex side which is inferior-surface-of-tongue 1a of a light guide plate 1 carries out outgoing radiation outside as a lighting light 15 from the optical outgoing radiation side which is upper surface 1b of a light guide plate in the case of such propagation. The lighting light 15 which carried out outgoing radiation outside illuminates a liquid crystal panel 7 from behind, as shown in drawing 1 (b).

[0021] The great portion of light which carried out outgoing radiation from Light Emitting Diode reaches side 1c of a light guide plate 1 in the case of the above-mentioned lighting. Since the distance d of Light Emitting Diode2 and side 1c is small as much as possible as mentioned above in this, the aforementioned outgoing radiation light is because side 1c is enough reached in the range of a latus solid angle. the material of the light guide plate 1 in the gestalt of this operation -- for example, those with a polycarbonate, in this case a refractive index 1.53 it is -- critical angle thetac -- abbreviation It comes out thetac=39. As shown in drawing 2 , the behavior about a beam of light s1 which carries out incidence to the flat-surface section 1c2 among the beams of light which reached side 1c is the same as that of the case of the conventional light guide plate already explained using drawing 6 , and abbreviation, and omits explanation. Next, before explaining the behavior of a beam of light s2 which carries out incidence to the heights 1c1 of ON light side 1c, general explanation is given per inclination of change of the outgoing radiation angle theta 2 accompanying change of an incident angle theta 1. Deflection of the refraction which is a difference with the outgoing radiation angle theta 2 about what has the small incident angle theta 1 when the incidence of light is made to a member with a refractive index higher than 1 like the light guide plate of this example out of air delta theta=theta 1-theta2 It is small and there is outgoing radiation light in the direction near extension of an incident light. On the other hand, if an incident angle theta 1 becomes large, aforementioned deltatheta which is the deflection of refraction will become large, and outgoing radiation light takes the angle which inclined greatly towards the inside from extension of an incident light. The principle of Snell shown in (1) formula can explain this reason. That is, it is the angle of deflection when an incident angle theta 1 is 90? according to the (1) formula. delta theta=theta 1-theta2 It is set to 90?-thetac (critical angle), for example, omits. Although it becomes deltatheta=50?, if an incident angle theta 1 decreases, angle deltatheta of deflection will also decrease and an incident angle theta 1 will approach 0?, angle deltatheta of deflection will also approach 0?.

[0022] Here, about s2, beam of light which carried out incidence to the prism side of the heights 1c1 of ON light side 1c, the outgoing radiation angle theta 2 can be conventionally increased effectively according to the effect of the tilt angle alpha of the field. This reason is actual incident angle theta1e in the aforementioned prism side even if the incident angle [incident angle / of an incident light s2] theta 1 on the basis of the aforementioned flat-surface section 1c2 is size comparatively. theta1 e=theta 1-alpha Since it becomes and remarkable reduction is carried out rather than theta 1 It is because angle deltatheta of deflection also decreases and the direction of outgoing radiation light turns into a direction near extension of an incident light s2 by the above-mentioned principle. Therefore, if the tilt angle alpha of the aforementioned prism side is set up appropriately, even the range which exceeds critical angle thetac for the outgoing radiation angle theta 2 on the basis of the field of the flat-surface section 1c2 can fully be increased. If the above is summarized, it will set in the gestalt of this operation. ON light side 1c according to the effect of the inclination of the prism side in the heights 1c1 of the shape of established prism The outgoing radiation angle theta 2 can be conventionally increased also to a beam of light with the large incident angle theta 1 which carries out incidence to ON light side 1c, and the angle range of the outgoing radiation light to the light guide plate 1 interior can be increased about the whole ON light side 1c more sharply than before as a result. In addition, since the field of the prism which is plane of incidence is extended [abbreviation] in the direction of the thick taste of a light guide plate 1, refraction distributes up and down, coming out out of a light guide plate 1 immediately has few beams of light which carried out incidence to the interior of prism-like heights 1c1 shell, and where the inside of a light guide plate 1 is spread widely, they are changed into lighting light. Such an effect may be acquired even when the prism side crosss diagonally in the direction of the thick taste of a light guide plate.

[0023] Drawing 3 is the plan showing the distribution state of the optical propagation way inside the light guide plate 1 in the gestalt of operation of **** 1. Since incidence of the incident light is substantially carried out to a light guide plate 1 in the range near the opposite section of Light Emitting Diode like the conventional field-like light source shown in drawing 6 , although the width of face of the field at the time of leaving of 11s of optical propagation ways is the same as usual the principle which described above the direction of [in the case of the start of 11s of optical propagation ways] -- the angle range -- critical angle thetac -- exceeding -- the former -- rather -- the latus angle range -- ** -- it has become Therefore, the existence region G1 of 11s of optical propagation ways near the side 1c has spread conventionally. 11s of optical propagation ways does not exist in the side of an existence region G1, but although there is a blank field H1 lighting light (15) does not carry out [a field] outgoing radiation directly, only the part in which the existence region spread is reducing the blank field sharply rather than the case of the conventional light guide plate shown in drawing 6 . In addition, there is a crimp in the base also in the blank field H1, and outgoing radiation of the lighting light is indirectly carried out in an operation of the crimp of the base also in the blank field H1 in response to the-like secondary wraparound resulting from dispersion of the light by the crimp of the base of an existence region G1. However, brightness fell sharply by most in which a blank field includes the center section with latus like before, and the ununiformity with remarkable brightness was brought about. However, in the gestalt of this operation, the brightness of lighting light depended for the size of the blank field H1 being fully narrower than before, turning, and crowding is seldom falling as compared with the brightness of an existence region G1. Therefore, the brightness of the lighting light 15 becomes uniform substantially also [near the ON light side 1c of a light guide plate 1].

[0024] Therefore, in order to make lighting light bright, when according to the gestalt of operation of **** 1 the side of a light guide plate is approached extremely and Light Emitting Diode has been arranged, the homogeneity of the brightness of the lighting light which carries out outgoing radiation from ** light guide plate can be raised more effectively than before. ** Thereby, the display quality of the panel illuminated can be raised. In addition, the same effect is acquired, even when this invention uses only one Light Emitting Diode depending on the configuration of not only this but a light guide plate, although two or more Light Emitting Diodes were used as a source of luminescence in the gestalt of operation of **** 1. Moreover, even if the luminescent color of two or more Light Emitting Diodes is the thing of the luminescent color from which not only the same color but R, G, B, etc. differed, its homogeneity of the brightness of the lighting light by color mixture improves conventionally.

[0025] The light guide plate applied to the gestalt of operation of the 2nd of this invention below based on a drawing is explained. Drawing 4 is the partial enlarged view showing the composition near the ON light side of the field-like light source of an edge light method using the light guide plate concerning the gestalt of operation of **** 2, (a) is a plan and (b) is the perspective diagram of the ON light side. In addition, the composition of the whole field-like light source concerning the gestalt of operation of **** 2 and the sign of a member are the same as that of the case of the field-like light source shown in drawing 1 except for the aforementioned optical incidence side. As shown in drawing 4 , two or more slots 1c3 where the cross section extended in the thickness direction of a light guide plate is circular are distributed over abbreviation homogeneity, and are established in ON light side 1c of a light guide plate 1. It is the flat-surface section 1c4 between the slot 1c3 and the slot 1c3.

[0026] Although the pars basilaris ossis occipitalis and the flat-surface section 1c4 of a slot 1c3 are penetrated and it is refracted from Light Emitting Diode2 among the light which reached ON light side 1c as shown in drawing 4 (a), the behavior of the incident light explained in the conventional example shown in drawing 6 is the same, and omits explanation. About the beam of light which carries out incidence to the flank of a slot 1c3, the angle range of the outgoing radiation [try] angle on the basis of the flat-surface section 1c4 can be extended by the same principle exceeding a critical angle more sharply than before as fundamentally as the effect of the inclination of plane of incidence having already explained in the 1st operation gestalt. In addition, it is changed into lighting light, after it being scattered about up and down and coming out out of a light guide plate 1 by refraction immediately, since the field of the slot which is plane of incidence has become in the direction of the thick taste of a light guide plate [abbreviation] had few beams of light which carried out outgoing radiation to the interior of a light guide plate 1 from the slot 1c3 and they have spread the inside of a light guide plate 1 widely. Thus, also in the gestalt of operation of **** 3, like the case of the gestalt of the 1st operation, the existence region (G1) of the optical propagation way in the light guide plate 1 near the ON light side 1c can be extended more sharply than before, and the blank field (H1) which was shown in drawing 1 and where an optical propagation way does not exist can be reduced conventionally. Therefore, the gestalt of operation of **** 2 also has the already explained same effect as the gestalt of the 1st operation.

[0027] in addition — although illustration is omitted — as the modification of the gestalt of operation of **** 2 — a cross section — it is circular and there are some which have two or more heights of the shape of boiled fish paste extended in the direction of the thick taste of a light guide plate An incident light can be made to be able to penetrate in the latus angle range in boiled-fish-paste-like heights also in this case, and the same effect as the gestalt of the 2nd operation can be acquired.

[0028] The light guide plate applied to the gestalt of operation of the 3rd of this invention below based on a drawing is explained. The gestalt of operation of **** 3 is related with the example which prepared irregularity, such as various kinds of crimps, in the ON light side of a light guide plate 1. Drawing 5 is the partial expansion perspective diagram of ON light side 1c which shows configurations, such as various kinds of crimps, to the gestalt of the 3rd operation. Drawing showing the crimp in which (a) has the hollow 21 of many minute semi-spheres, drawing showing the crimp in which (b) has the heights 22 of much shape of a minute semi-sphere, Drawing showing the crimp in which (c) has the hollow 23 of much shape of a minute pyramid, drawing showing the crimp in which (d) has the heights 24 of much shape of a minute cone, and (e) are drawings showing the crimp which has the heights 25 of much shape of a minute pyramid. Although (f) cannot be called crimp, it is drawing showing the irregularity 26 of the shape of a hairline mentioned later. In addition, the composition of the whole field-like light source using the light guide plate concerning the gestalt of operation of **** 3 is the same as that of the case of the field-like light source shown in drawing 1 except for the aforementioned optical incidence side.

[0029] In these crimps, by the gap tilt effect of the plane of incidence of the inside of the hollow, the incident light which arrived at the semi-sphere-like hollow 21 and the ******-like hollow 23 is the principle same with having already explained, and can make size the outgoing radiation angle of the outgoing radiation light to the light guide plate 1 interior. Moreover, there is same inclination by the gap tilt effect of plane of incidence also about the incident light which reached the semi-sphere-like heights 22, the cone-like heights 24, and the pyramid-like heights 25. Thus, about the outgoing radiation light of the outgoing radiation inside [by the optical refraction which reached ON light side 1c by which this crimp processing was made] a light guide plate, when it sees as a whole, it becomes possible to extend more sharply than this conventionally the angle range of the outgoing radiation light restricted to below the critical angle. Therefore, equalization of the brightness of lighting light which carries out outgoing radiation from a light guide plate conventionally is improvable with the principle same with having already explained.

[0030] In addition, there are some which consist of a hollow of the shape of much cone in addition to this as a configuration of a crimp although illustration is omitted. Although the heights or the hollow of the same size was uniformly arranged about the configuration of the crimp of ON light side 1c described so far as shown in drawing 5 (a), (b), (c), (d), and (e) The configuration of the crimp concerning this invention has the same effect as the aforementioned crimp, when the heights or the hollow of not only this but an uneven size is arranged irregularly.
[0031] Next, although drawing 5 (f) cannot say it as a crimp, it is the perspective diagram showing the crevice 26 (or you may be heights.) where the hairline configuration prepared in ON light side 1c is irregular. The same improvement effect as abbreviation is given for the same operation to nothing and a light guide plate by the same principle as fundamentally as ON light side 1c in which ON light side 1c which has the crevice (or heights) 26 of this hairline configuration also has the aforementioned crimp.

[0032]
[Effect of the Invention]

As explained above, in order to raise the luminosity of the lighting light which carries out outgoing radiation from a light guide plate in the field-like light source of an edge light method according to this invention, when sources of luminescence, such as Light Emitting Diode, are made to approach a light guide plate as much as possible, the homogeneity of the brightness of the lighting light which carries out outgoing radiation from ** light guide plate is raised conventionally, things are made and the display quality of the panel which can ** Come, is alike and is illuminated more can be raised.

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the composition of the field-like light source using the light guide plate concerning the gestalt of operation of the 1st of this invention.
[Drawing 2] It is the enlarged view of the B section in drawing 1 .
[Drawing 3] It is the plan showing the distribution state of the optical propagation way inside the light guide plate used for the field-like light source shown in drawing 1 .
[Drawing 4] It is drawing showing the configuration of the ON light side of the light guide plate concerning the gestalt of operation of the 2nd of this invention.
[Drawing 5] It is drawing showing the configuration of the ON light side of the light guide plate concerning the gestalt of operation of the 3rd of this invention.
[Drawing 6] It is drawing showing the composition of the field-like light source using the conventional light guide plate.

[Description of Notations]
1 Light Guide Plate
1c ON light side
1c1 Prism-like heights
1c2, 1c4 Flat-surface section
1c3 Slot
2 LED
3 Light Emitting Diode Substrate
7 Liquid Crystal Panel
10 Field-like Light Source
11s Optical propagation way
15 Lighting Light
21, 22, 23, 24, 25 Crimp
26 Hairline
G1 Existence region
H1 Blank field

* NOTICES *

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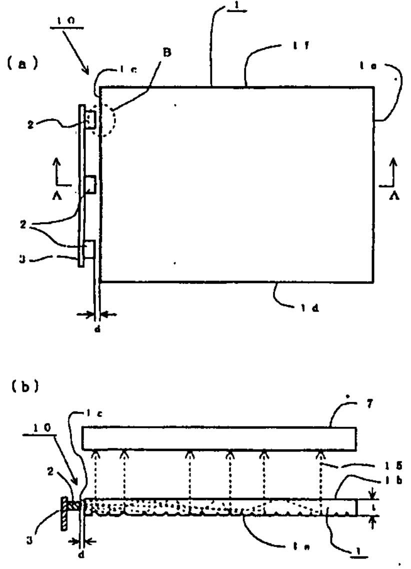
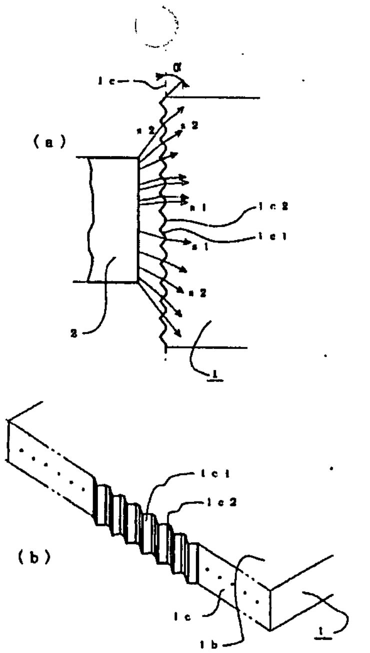
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

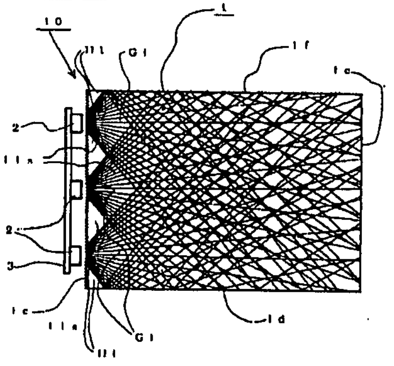
[Drawing 1]



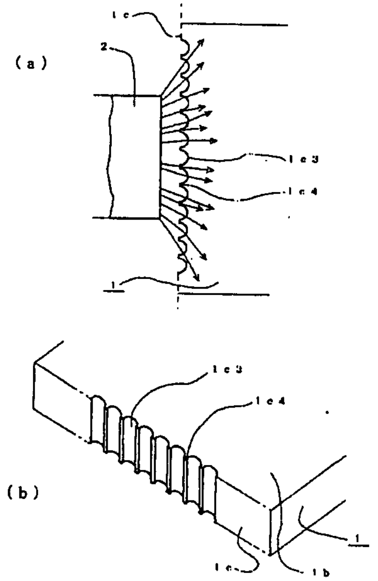
[Drawing 2]



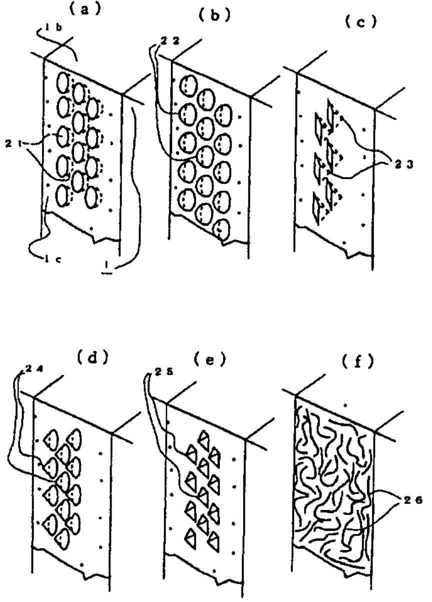
[Drawing 3]



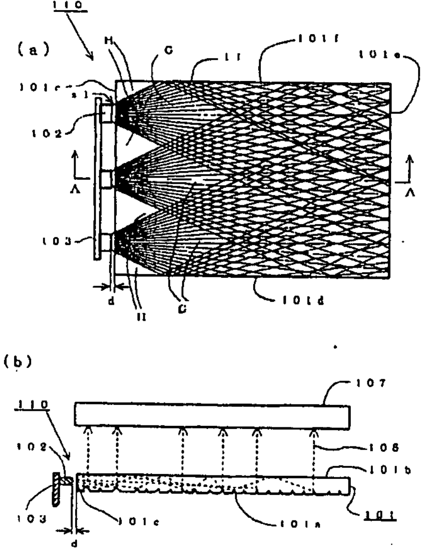
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]